

# PATENT ABSTRACTS OF JAPAN

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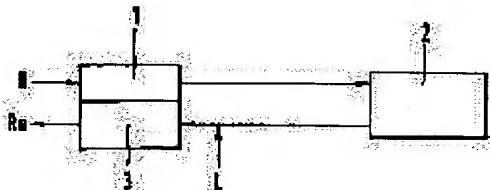
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## (54) DEVICE FOR UTILIZING HEAT GENERATED BY CATALYTIC REACTION

### (57)Abstract:

PROBLEM TO BE SOLVED: To execute catalytic reaction by using the constituent element as few as possible and also using the constituent element where each element and collected elements have small structures.

SOLUTION: In the device for utilizing the heat generated by the catalytic reaction, the first region (1) to be used for heating, particularly for vaporizing at least one starting material to be allowed to react, particularly reaction mixture and the third region (3) for executing at least partially the catalytic reaction or for allowing the reaction product generated by the catalytic reaction to moreover react and/or for cooling at least partially the reaction product generated by the catalytic reaction are provided, and the first region (1) and the second region (2) are connected so as to execute heat conduction.



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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the schematic drawing showing 1 desirable operation gestalt of the equipment by this invention for performing catalytic reaction.

[Drawing 2] It is the schematic drawing showing 1 operation gestalt to which the equipment by this invention for performing catalytic reaction was expanded.

[Drawing 3] It is the abbreviation sectional view of one equipment by this invention for using the heat produced on the occasion of catalytic reaction.

[Drawing 4] It is a sectional view turning around 90 degrees of equipment of drawing 3 .

[Drawing 5] It is the sectional view of drawing 3 and 1 desirable operation gestalt of the equipment by this invention of 4.

[Drawing 6] It is the abbreviation sectional view which looked at 1 desirable operation gestalt of the equipment by this invention for hydrogen generation from width.

[Description of Notations]

1 The 1st Field / Heating Apparatus / Carburetor

2 Reformer / Catalyst Equipment

2a Catalyst equipment layer

3 The 2nd Field / CO Oxidation System / Reforming Object Cooling System

5 Starting Material Preheating Equipment

7 Expansion Parts of CO Oxidation System / Reforming Object Cooling System

10 Septum

11 Duct

12 Starting Material Duct

13 Conduit

20 Housing

21 Middle Tooth Space

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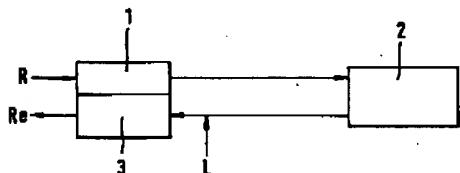
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DRAWINGS

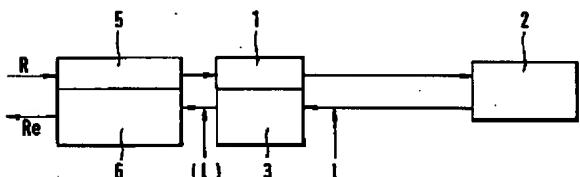
[Drawing 1]

**Fig.1**



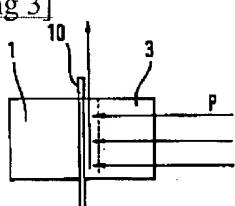
[Drawing 2]

**Fig.2**



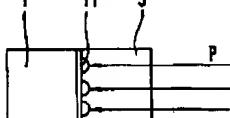
[Drawing 3]

**Fig.3**

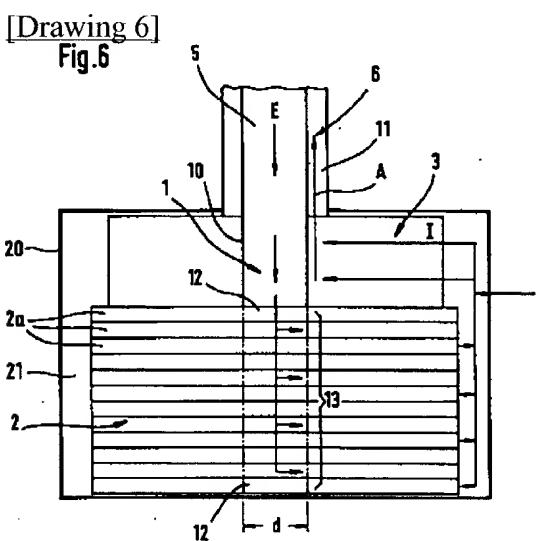
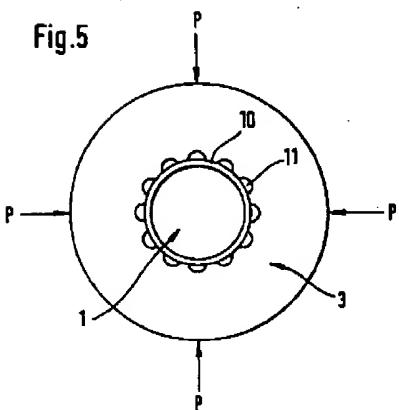


[Drawing 4]

**Fig.4**



[Drawing 5]



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## DETAILED DESCRIPTION

### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the approach of carrying out the equipment using the heat produced in the case of catalytic reaction equipped with the 2nd field for cooling partially at least the resultant produced in the case of the catalytic reaction for making the resultant produced in the case of the 1st field for heating at least one starting material which should be made reacting, and the catalytic reaction for performing catalytic reaction partially at least reacting further, and its catalytic reaction.

[0002]

[Description of the Prior Art] For example, it becomes a target to hold down as small as possible the mass, the volume, and costs of a component required also in the case of the use accompanied by the field of an automobile and other migration. In order to enable it to perform the start between the colds satisfactory, the gross mass of a component required for transit must be low, and the gas path which ties both components must be short as much as possible.

[0003] The so-called non-homogeneous system catalytic reaction is supplying the reaction mixture containing a hydrocarbon or alcohol, and water to catalyst equipment, and producing hydrogen from a hydrocarbon or alcohol, especially a methanol (methanol reforming). There is combustion of the carbon monoxide reduction performed by separating a carbon dioxide by the so-called hydrogen water gas shift reaction as other examples, the carbon monoxide oxidization which leads CO content gas and O<sub>2</sub> content gas to catalyst equipment, and performs them, and the inflammable starting material (edukt) performed by adding O<sub>2</sub> content gas in a catalyst burner.

[0004] In the case of a hydrogen drive car, required hydrogen is usually obtained from a hydrocarbon or alcohol, for example, a methanol, on a car. It is CH<sub>3</sub> OH+H<sub>2</sub> O->CO<sub>2</sub>+3H<sub>2</sub> that the hydrogen generation from a methanol serves as a foundation of the whole reaction. The reaction mixture containing a methanol and a steam is met and led to suitable catalyst equipment, supplying heat in fact, in order to react this kind. This is a thing which generates the hydrogen of hope in a single stage or two or more steps of reaction processes and to perform for accumulating. What performs two-step methanol reforming with this kind of equipment is known for EP 0687648A1. With this known equipment, a reaction mixture is led to the 1st reactor aiming only at partial deterioration of a methanol. After flowing through the 1st reactor, the gas mixture object containing the starting material part which has not deteriorated yet is led to the 2nd reactor of the structure optimized for residual object deterioration.

[0005] In order for catalyst equipment to enable it to operate effectively, before leading starting material to a reactor, it is necessary to evaporate. Since a heat transfer field big for that is the need, the heat exchanger of a plate mold or tube bundle mold structure is usually used.

[0006] This kind of heat exchanger is used also in order to perform the procedure phase of others in the case of catalytic reaction. For example, in order to heat or cool the occurring gas, or in order to supply heat to a catalysis ingredient, it is for taking heat from these ingredients as required.

[0007] For example, the fault which is that it is sudden in the case of the known equipment for generating hydrogen from a hydrocarbon has many number of required components, especially

components of a heat exchanger, and is that equipment serves as big structure as a whole for this reason. however, in order to use in the field especially accompanied by migration, it is called for that costs this - - also stop the mass of a required component and the volume as small as possible.

[0008]

[Problem(s) to be Solved by the Invention] The purpose of this invention has some which moreover summarized the fewest possible components, each itself, and the whole in performing catalytic reaction using the component which is small structure.

[0009]

[Means for Solving the Problem] The 1st field (1) for the above-mentioned purpose to heat at least one starting material which should be made to react, In order to make the resultant produced in the case of the catalytic reaction for performing catalytic reaction partially at least react further, And/or, it is equipment using the heat produced in the case of catalytic reaction equipped with the 2nd field (3) for cooling partially at least the resultant produced in the case of catalytic reaction. It is attained by the equipment connected so that the 1st field (1) and 2nd field (3) may heat-conduct. The above-mentioned purpose Moreover, the heating apparatus/carburetor for heating or evaporating at least one starting material which should be made to react (1), In order to make the catalyst equipment (2) for performing catalytic reaction partially at least, and the resultant produced in the case of catalytic reaction react further, And/or, it is equipment which performs catalytic reaction equipped with the equipment (3) connected to the lower stream of a river of the catalyst equipment (2) for cooling this, and is attained by the equipment combined so that heating apparatus/carburetor (1), and equipment (3) may heat-conduct. The above-mentioned purpose Moreover, the process which evaporates at least one starting material which should be made to react, It is the approach of performing catalytic reaction including the process to which catalytic reaction of the evaporated starting material is carried out partially at least, and the process which reacts and/or cools further the resultant which arose on the occasion of catalytic reaction. It is attained by the approach of using the heat emitted in case the resultant produced on the occasion of catalytic reaction in case it was catalytic reaction partial at least, and/or when it was the further reaction is cooled in order to promote evaporation.

[0010] The point that the equipment for the heat utilization by this invention is excellent is that the carburetor used in order to evaporate the starting material which should be made to react, or a carburetor field is the configuration unified or unified with the 2nd field. This 2nd field is for cooling partially at least the resultant produced in the case of catalytic reaction for the further reaction of the resultant produced in the case of catalytic reaction in order to perform catalytic reaction partially at least. For example, the 2nd field can be formed as a cooling system for cooling the reforming object (reformat) produced in the case of catalytic reaction as a CO oxidation system used in order to oxidize the carbon monoxide produced in the case of catalytic reaction in the case of methanol reforming. By connecting so that heat may conduct between these two fields, most use of the further heat exchanger can be excluded, or can lessen that use remarkable.

[0011] Suitably, the thermally conductive septum which does not penetrate a gas is formed between the 1st and 2nd fields. Contacting CO or reforming object gas which the starting material which should be evaporated produces by this in the case of catalytic reaction is prevented.

[0012] In order to stop the thermal stress in a septum side as small as possible, a flow direction makes the side of one of these at least perpendicular to a septum side or a septum. Thereby, a septum top is substantially adjusted by the isothermal condition.

[0013] In one desirable operation gestalt of the equipment by this invention for heat transfer, the 1st and/or the 2nd field are mainly especially manufactured with the metal ingredient with sufficient thermal conductivity by porosity. An available heat exchange side becomes large by this measure. Since the gas or the liquid flowing through is strongly mixed by the vesicular structure and a vortex can furthermore be given with it, good heat transfer is obtained.

[0014] As a suitable approach, the catalyst matter can be included in at least one of each fields.

[0015] Especially if it has a solid part, it turns out that each field of each field, especially a septum part is advantageous. Thereby, heat conduction to a septum or a cutoff side is improved by the effective

approach.

[0016] With 1 especially desirable operation gestalt of the equipment by this invention for heat utilization, the 1st and 2nd fields were mutually made into the configuration of a concentric circle, it is tubular in that case, the 1st field is arranged inside the septum which does not penetrate a gas, and the 2nd field is arranged outside. With this kind of configuration, even if a structure tooth space is small, the resultant which should be cooled, for example can be added to homogeneity to the 2nd field radial.

[0017] It is suitable to enable it to take out the gas which prepared the duct in the form of being parallel to a septum, and was added to the 2nd field side to the 2nd field in the septum part. It is enough cooled in the 2nd field and the resultant which emitted heat reusable to heating of the 1st field with it can be taken out from the 2nd field satisfactory by the effective approach by this measure.

[0018] This equipment is made from one advantageous gestalt of the equipment by this invention for performing catalytic reaction as equipment which generates the reaction mixture containing especially at least one a methanol and water to the hydrogen of a hydrocarbon and alcohol. In this case, in order that catalyst equipment may generate a reforming object, the equipment connected to the lower stream of a river of the catalyst equipment as a reformer which performs reforming of a reaction mixture, especially partial oxidation is made as a reforming object cooling system which cools the reforming object which produced within the reformer the carbon monoxide produced within the reformer as a CO oxidation system for oxidizing. Thereby, the equipment for very small hydrogen generation can be used, and especially this is the thing of structure which can be used in the automobile field.

[0019] This equipment is equipped with one equipment which will be accepted in order to cool the resultant which flows out of the equipment connected to the lower stream of a river of one equipment which will be accepted in order to heat beforehand the starting material led to heating apparatus/carburetor, and catalyst equipment with one desirable gestalt of the equipment by this invention for performing catalytic reaction. In this case, these added equipments are connected so that heat may conduct. Thereby, the heat produced on the occasion of catalytic reaction can be used the optimal by the effective approach.

[0020] It turns out that it is advantageous especially to make into the configuration of an integrated mold or one apparatus the equipment and catalyst equipment which were connected to the lower stream of a river of heating apparatus/carburetor, and catalyst equipment. By this measure, the small equipment of especially structure for performing catalytic reaction can be used, and especially this equipment fits use in the automobile field.

[0021] With one desirable gestalt of the approach by this invention, at least one of the approach of this is used in order [ of a hydrocarbon and alcohol ] to generate especially hydrogen from a methanol. In this case, for reforming object generation, within the catalyst equipment made as a reformer, reforming of the vaporized reaction mixture is carried out, and it oxidizes partially especially. And the reforming object which the carbon monoxide produced on the occasion of reforming was led to CO oxidation system, and/or was generated within the reformer is led to a reforming object cooling system. At this time, the heat emitted with CO oxidation system and/or the reforming object cooling system is used for promoting evaporation of at least one starting material. According to this kind of approach, the heat produced with the cooling system or CO oxidation system of a reforming object can be used by the approach easy for evaporation of the reaction mixture before a reaction, and effective.

[0022]

[Embodiment of the Invention] The desirable operation gestalt of this invention is separately explained using an attached drawing.

[0023] Drawing 1 shows the important component of the equipment by this invention for carrying out catalytic reaction for the equipment for hydrogen generation to an example in the form simplified in graph. In a carburetor 1, the reaction mixture (an arrow head R shows supply of a reaction mixture) containing a methanol and water is evaporated, and it is led to the reformer 2 (POX reformer) for partial oxidation. In a reformer 2, deterioration by the catalyst to the reforming object which contains hydrogen from a reaction mixture is performed partially at least. Not only hydrogen but [ especially ] the reforming object containing a carbon monoxide (CO) is led to CO oxidation system or the reforming

object cooling system 3 (below, it is described as a component 3), some carbon monoxides [ at least ] contained there oxidize, and a reforming object is cooled by coincidence. The cooled reforming object is led to a fuel cell (not shown here) succeedingly (connecting another reforming object cooling system in the middle depending on the case) (arrow head Re). The air for oxidizing the contained carbon monoxide is mixed in a reforming object between a reformer 2, CO oxidation system, or the reforming object cooling system 3 (an arrow head L shows).

[0024] A carburetor 1 and the component 3 of each other are stuck, or are the configuration of one apparatus, and they are connected so that heat may conduct between these. Thereby, the high heat content of the reforming object produced in the reformer 2 is transmitted to a carburetor 1, and evaporates a reaction mixture. The waste heat furthermore produced on the occasion of CO oxidation can be used for the same purpose. The temperature distribution which descend to the order which met the overall length of the CO oxidation system 3, and was produced by cooling show that alternative CO oxidation can be performed, and this is an especially advantageous point. Note that the evaporation temperature of the reaction mixture in a carburetor 1 is clearly lower than the temperature of the reforming object which flows out of a reformer 2. The produced reforming object follows and is cooled by the effective approach by the evaporation of a reaction mixture performed to coincidence.

[0025] The high engine performance becomes possible according to the gas path from a carburetor side to CO oxidation system side or a reforming object cooling-system side being short, and there being comparatively little gas volume.

[0026] The reformer 2 is especially understood [ the configurations of components 1 and 3 and an integrated mold, then ] are convenient. This is further explained to the following in relation to the desirable operation gestalt of the equipment for hydrogen generation.

[0027] Although drawing 2 shows another desirable operation gestalt of this equipment for hydrogen generation, this is extended as compared with the equipment of drawing 1, and another equipment 6 used as equipment 5, and CO oxidation system or the reforming object cooling system for a starting material preheating is added. With equipment 5, starting material can be heated to evaporation level and, on the other hand, equipment 6 can cool a reforming object to less than [ fuel cell temperature or it ]. What (arrow head L) air can be further supplied for to a reforming object among components 3 and 6 is understood. Like arrangement of the carburetor-CO oxidation system of an integrated mold, or the carburetor-reforming object cooling systems 1 and 3, equipments 5 and 6 are connected so that heat may conduct the meantime.

[0028] When you add air or oxygen among equipments 3 and 6 (or 2 and 3), note that 1more CO oxidation stage can be prepared in equipment 6. This is applied especially when forming the catalyst equipment for it.

[0029] The integrated mold of a carburetor 1, CO oxidation system, or the reforming object cooling system 3 showed the desirable operation gestalt separately by drawing 5 from drawing 3. The number [ field / which was illustrated / of equipment / the carburetor or carburetor field ] also in here 1 is attached, and the number [ field / where CO oxidation or its cooling of a reforming object is performed ] 3 is attached. The septum 10 which does not penetrate a gas is formed among fields 1 and 3. Fields 1 and 3 are manufactured with the thermally conductive good metallic material by porosity. A big heat exchange side by this is acquired. Good heat transfer or heat absorption is further obtained from the gas flowing through with this kind of vesicular structure. The matter which flows through a porous material is mixed strongly, and since a vortex can be given, this operation is acquired. According to the fact that a flow direction is generated mainly in a septum and a perpendicular, a septum shows the unified temperature.

[0030] Although drawing 4 is what was shown from the direction turning around 90 degrees of drawing 3 (top view), notice it about the duct 11 formed in the field 3 here. This duct 11 is flowing through at right angles to a septum 10 in the direction [ gas / in the direction /, i.e., the reforming object showed the field 3 by the arrow head P, / in which a resultant or a reforming object is taken out especially again ] and and. By this, when flowing through a field 3, the gas which emits heat can be taken out satisfactory. The heat emitted in the field 3 can be transmitted to a field 1 after that through the septum 10 which

does not penetrate a gas.

[0031] One especially desirable gestalt of the integrated mold of a carburetor, CO oxidation system, or a reforming object cooling system was shown in drawing 5. Note that fields 1 and 3 are the configurations of the field of a concentric circle or a cylindrical shape, and being mutually intercepted by the septum 10 of the cylindrical shape with which these fields do not penetrate a gas. The duct 11 is formed in the part of a septum 10 like drawing 3 and drawing 4 also here. In this case, the gas which should be cooled flows [ be / it / under / of it / passing ] to radial toward a field 3, as an arrow head P shows by drawing 5. In this case, side the starting material which should be heated and which should be \*\*\*\*\*\*(ed) again will turn to a drawing flat surface through the inside field 1 in the place which shaft orientations, i.e., drawing 5, show, it flows to the side here. The gas which flows through the outside field 3 to radial emits the heat to the porous material of a field 3, and side this will also turn to a drawing flat surface through a duct 11 in the place which drawing 5 shows in parallel with a septum 10, it flows to the side here. The heat emitted to the outside field 3 is transmitted to the inside field 1 via a septum 10, and promotes evaporation of the starting material which flows through the inside field 1.

[0032] Drawing 6 shows 1 desirable operation gestalt of the equipment by this invention for hydrogen generation to the last. In the case of this equipment, a carburetor, a reformer and CO oxidation system, and/or a reforming object cooling system are the configurations of one apparatus or an integrated mold.

[0033] The same component as having been assigned [ a number ] and illustrated by drawing 5 from drawing 1 gives the same number also here.

[0034] It accumulates, and the reformer 2 which is the configuration of a mold reactor consists of what was accumulated mutually, accumulates each catalyst equipment layer 2a, and is a mold reactor. Each catalyst equipment layer 2a is fabricated by the layer with a front face it is thin and large compressed strongly by press working of sheet metal of for example, a catalyst equipment ingredient. As a catalyst equipment ingredient, a particle diameter uses fine grain-like the catalyst equipment powder or granulation not more than about 0.5mm or it, for example. This press working of sheet metal is performed at the temperature from 200 degrees C to 500 degrees C. With the illustrated operation gestalt, it has the starting material duct 12 which extends almost in parallel with a long side into catalyst equipment layer 2a. This duct forms the conduit 13 perpendicularly penetrated to the flat surface of catalyst equipment layer 2a (the dotted line showed). A starting material duct or a conduit 13 is formed in the center of each catalyst equipment layer 2a with the illustrated operation gestalt, and the diameter is d. It accumulated, and the reformer 2 which is the configuration of a mold reactor was equipped with the duct which is not illustrated according to an individual here, and these ducts are extended through each catalyst equipment layer 2a at right angles to the direction where the starting material duct 13 is extended. It sticks on a reformer 2 and the equipment which numbered and illustrated the number from drawing 3 to drawing 5 is attached. The 1st field 1 used as a carburetor is arranged together with the starting material duct 13 and the single tier here. The field 3 which surrounds a field 1 in the shape of a concentric circle is a thing for CO oxidation or reforming object cooling, and its die length prolonged in radial [ the ] is shorter than that of each catalyst equipment layer 2a a little. The reformer 2, the carburetor 1 and CO oxidation system, or the reforming object cooling system 3 is arranged inside housing 20. It turns out that the dimension of housing 20 is decided so that the middle tooth space 21 may remain between a reformer 2, and the CO oxidation system / reforming object cooling system 3.

[0035] In order to make legible the duct established in the septum part in order that the septum which does not penetrate the gas between a carburetor 1, and the oxidation system / reforming object cooling system 3 might take out the gas by which the interior of an oxidation system / reforming object cooling system was cooled in accepting it in graph and being shown, and this case, please care about having excluded that illustration. Only the duct extension which projects from an oxidation system / reforming object cooling system was illustrated.

[0036] The starting material which should be made to react is a reaction mixture which usually contains a methanol and water, when generating hydrogen, but this is led to the evaporation field 1, as an arrow head E shows. Via the starting material duct 13 (going via the duct which is not illustrated according to an individual), the reaction mixture evaporated with the carburetor 1 is led to each catalyst equipment

layer 2a, and the catalytic reaction of a reaction mixture produces it there. As the arrow head beside drawing shows, the gas which reacted partially is led to outflow and the upper part from the outside of catalyst equipment layer 2a, and is added to CO oxidation system / reforming object cooling system 3 toward radial from an outside. The gas or the resultant heated by catalytic reaction emits the (arrow head I) heat, when flowing through CO oxidation system / reforming object cooling system 3 to radial toward the inside, it passes along the duct 11 only illustrating the field projected from the oxidation system / reforming object cooling system by drawing 6, and flows out of CO oxidation system / reforming object cooling system 3 (arrow head A). The heat emitted with CO oxidation system / reforming object cooling system 3 is transmitted to the evaporation field 1, and evaporates the flowing starting material.

[0037] Although it has with the gestalt which unified the reformer, the carburetor, and the CO oxidation system / reforming object cooling system, the operation gestalt which a number was assigned and was shown in drawing 6 has a very short gas path, and since there is comparatively little gas volume used, especially the use especially accompanied by migration understands that it is convenient.

[0038] The arrangement which numbered the equipment for hydrogen generation and showed it to the example at drawing 6 can be used for other catalytic reaction, i.e., the catalytic reaction which produces heat of reaction on the other hand, and must heat or evaporate starting material on the other hand.

[0039] The configuration desirable as equipment for a starting material preheating extended the carburetor or the evaporation field 1, and it assigned a number to drawing 2 with 5, and showed this. In addition, the extension of the duct 11 illustrated by giving a number 6 to drawing 2 is an advantageous configuration as a cooling system. This kind of equipments 5 and 6 can prepare a duct-like progress part, as direct continuation can also be carried out to the equipment shown in drawing 6 or it is shown for example, in this Fig., and they can also take spacing of hope.

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**CLAIMS**

[Claim(s)]

[Claim 1] The 1st field (1) for heating at least one starting material which should be made to react, In order to make the resultant produced in the case of the catalytic reaction for performing catalytic reaction partially at least react further, And/or, equipment which is equipment using the heat produced in the case of catalytic reaction equipped with the 2nd field (3) for cooling partially at least the resultant produced in the case of catalytic reaction, and is characterized by being connected so that the 1st field (1) and 2nd field (3) may heat-conduct.

[Claim 2] Equipment according to claim 1 characterized by forming the thermally conductive septum (10) which does not penetrate a gas between the 1st field (1) and the 2nd field (3), and generating the flow direction in the case of cooling and/or heating at right angles to said septum.

[Claim 3] Equipment according to claim 1 or 2 characterized by manufacturing partially the 1st field (1) and/or 2nd field (3) with a thermally conductive good ingredient by porosity at least.

[Claim 4] Equipment according to claim 1 to 3 characterized by equipping at least one of said fields (1 3) with a catalyst ingredient.

[Claim 5] Equipment according to claim 1 to 4 with which said field (1 3) is characterized by having the part of the configuration of a solid.

[Claim 6] Equipment according to claim 1 to 5 characterized by having the septum (10) of the shape of tubing which the 1st field (1) and 2nd field (3) are the configuration of this alignment mutually, and does not penetrate the gas by which the 1st field (1) is arranged inside and the 2nd field (3) is arranged outside.

[Claim 7] In order to make the heating apparatus/carburetor for heating or evaporating at least one starting material which should be made to react (1), the catalyst equipment (2) for performing catalytic reaction partially at least, and the resultant produced in the case of catalytic reaction react further, And/or, equipment which is equipment which performs catalytic reaction equipped with the equipment (3) connected to the lower stream of a river of the catalyst equipment (2) for cooling this, and is characterized by being combined so that heating apparatus/carburetor (1), and equipment (3) may heat-conduct.

[Claim 8] The equipment (3) by which catalyst equipment was formed as a reformer which performs reforming of a reaction mixture in order to generate a reforming object, and it was connected to the lower stream of a river the carbon monoxide produced in the reformer (2) as a CO oxidation system for oxidizing And equipment according to claim 7 for generating hydrogen from the reaction mixture containing at least one and water of the hydrocarbon and alcohol which are characterized by being formed as a reforming object cooling system (3) for cooling the reforming object produced in/or a reformer.

[Claim 9] Equipment according to claim 7 or 8 characterized by being combined so that it may have one equipment (5) which will be accepted in order to heat beforehand the starting material led to heating apparatus/carburetor (1), and one equipment (6) which will be accepted in order to cool further the resultant which flowed out of equipment (3) and said equipment (5 6) may heat-conduct.

[Claim 10] Equipment according to claim 7 to 9 characterized by forming in an integrated mold or one apparatus the equipment (3) and catalyst equipment (2) which were connected to the lower stream of a river of heating apparatus/carburetor (1), and catalyst equipment.

[Claim 11] The process which evaporates at least one starting material which should be made to react, and the process to which catalytic reaction of the evaporated starting material is carried out partially at least, It is the approach of performing catalytic reaction including the process which reacts and/or cools further the resultant produced on the occasion of catalytic reaction. The approach characterized by using the heat emitted in case the resultant produced on the occasion of catalytic reaction in case it was catalytic reaction partial at least, and/or when it was the further reaction is cooled in order to promote evaporation.

[Claim 12] Reforming is carried out within the catalyst equipment with which the reaction mixture evaporated in order to generate a reforming object was formed as a reformer (2). The reforming object which led the carbon monoxide produced at the process of reforming to CO oxidation system, and/or was generated within the reformer is led to a reforming object cooling system (3). The approach according to claim 11 for generating hydrogen from the reaction mixture containing at least one and water of the hydrocarbon and alcohol which are characterized by using the heat emitted in the case of CO oxidation and/or reforming object cooling in order to promote evaporation of a reaction mixture.

[Claim 13] The 1st field (1) for heating at least one starting material which should be made to react, In order to make the resultant produced on the occasion of the catalytic reaction for performing catalytic reaction partially at least react further, And/or, it has the 2nd field (3) for making the resultant produced on the occasion of catalytic reaction cool partially at least. Are combined so that the 1st field (1) and 2nd field (3) may heat-conduct. Are equipment using the heat produced on the occasion of catalytic reaction, and the thermally conductive septum (10) which does not penetrate a gas is formed between the 1st field (1) and the 2nd field (3). Equipment characterized by being generated at right angles to a cutoff side in the case of heating which the flow direction of the resultant in the 2nd field (3) produces by the catalytic reaction partial at least in the case or the further reaction of cooling.

[Claim 14] The heating apparatus/carburetor for heating or evaporating at least one starting material which should be made to react (1), In order to make the catalyst equipment (2) for performing catalytic reaction partially at least, and the resultant produced on the occasion of catalytic reaction react further, And/or, it is equipment which performs catalytic reaction equipped with the equipment (3) connected to the lower stream of a river of the catalyst equipment (2) for cooling this. It is combined so that the equipment (3) connected with heating apparatus/carburetor (1) on the lower stream of a river may heat-conduct. The thermally conductive septum (10) which does not penetrate a gas is formed between the equipment (3) connected with heating apparatus/carburetor (1) on the lower stream of a river. Equipment characterized by going at right angles to a cutoff side in the case of heating which the flow direction of the resultant in the equipment (3) connected down-stream on that occasion produces by the catalytic reaction partial at least in the case or the further reaction of cooling.

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[Translation done.]